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# **A Fast Flow Control and Approach Queuing Monitor using FDP in Excel Environment**

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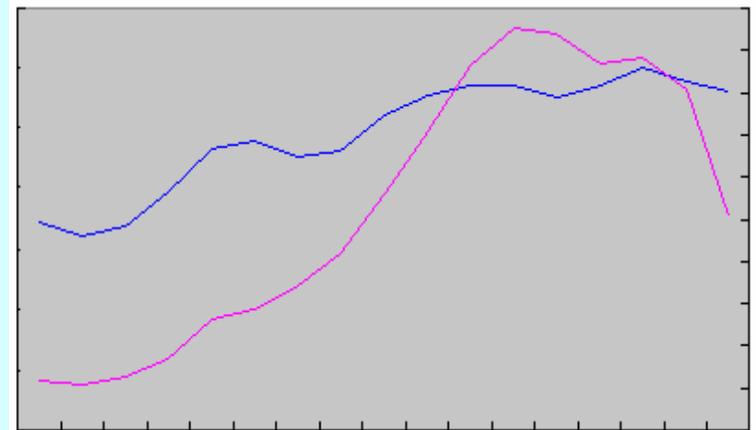
# Motivation

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The statistical daily flow changes steeply and drops quickly in Taipei Sung Shan Airport (TSA).

Typically short flight duration in performance that FDP data appear reliable and useful.

Developing a feasible tool to assist Controller to watch approach queuing.



# Development of pFAST

NASA Developed tools such as pFast in 1991 to quickly display flights in Dallas/FW Airport for ATC controllers from RDP.



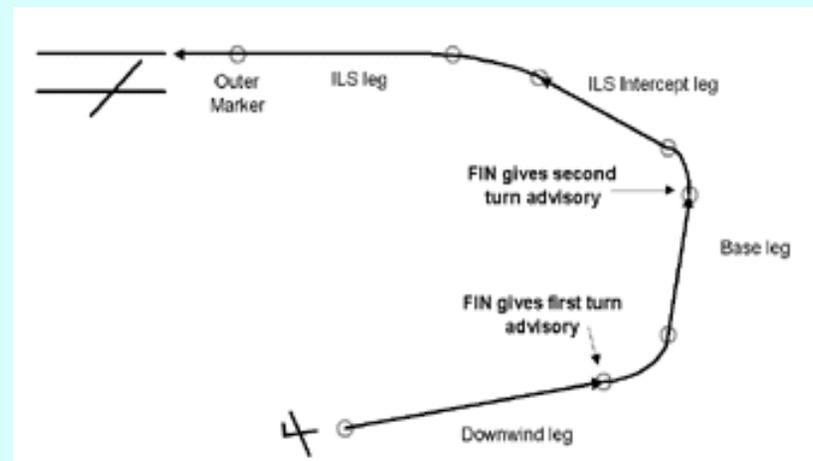
**FAST Speed and Turn Advisory Graphics**



# Development of FAST

Under ATMDC support, FAST was developed in 1995 to display and queue TCA flights in London/LHR Airport.

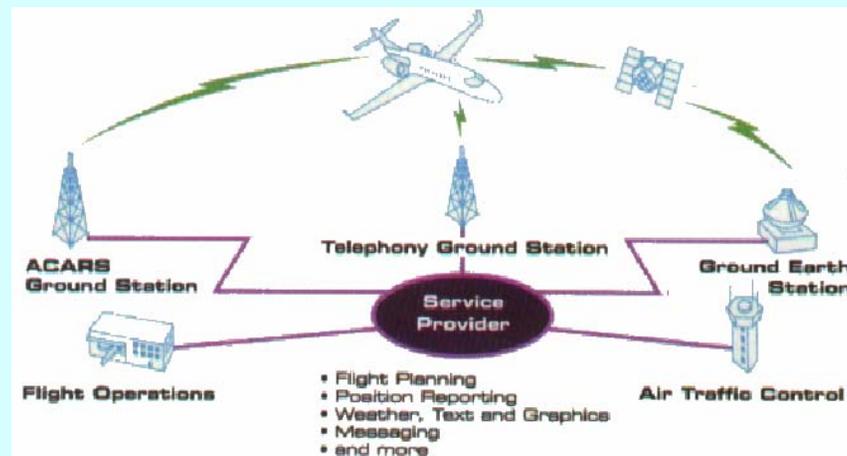
Complicate tools applied in these systems.



# OOOI in CNS/ATM

Out, Off, On, In (OOOI) time data can accurately acquired from ACARS/ADS-B support.

Metering fix data typically less than 30-40 minutes can offer flight landing time ("ON" time) forecast.



# Concept of this paper

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FDP data from flight plans are some statistical data from previous AOC records. It can be used to estimate certain short range flights. Once the metering fix obtains a coming flight, the "ON" time can be forecasted.

TSA operation in Taiwan is short, no longer than 55 minutes. Once an aircraft is taking off, the landing time can be estimated very closely.

The use of "OFF" time to estimate "ON" time from SAR data.

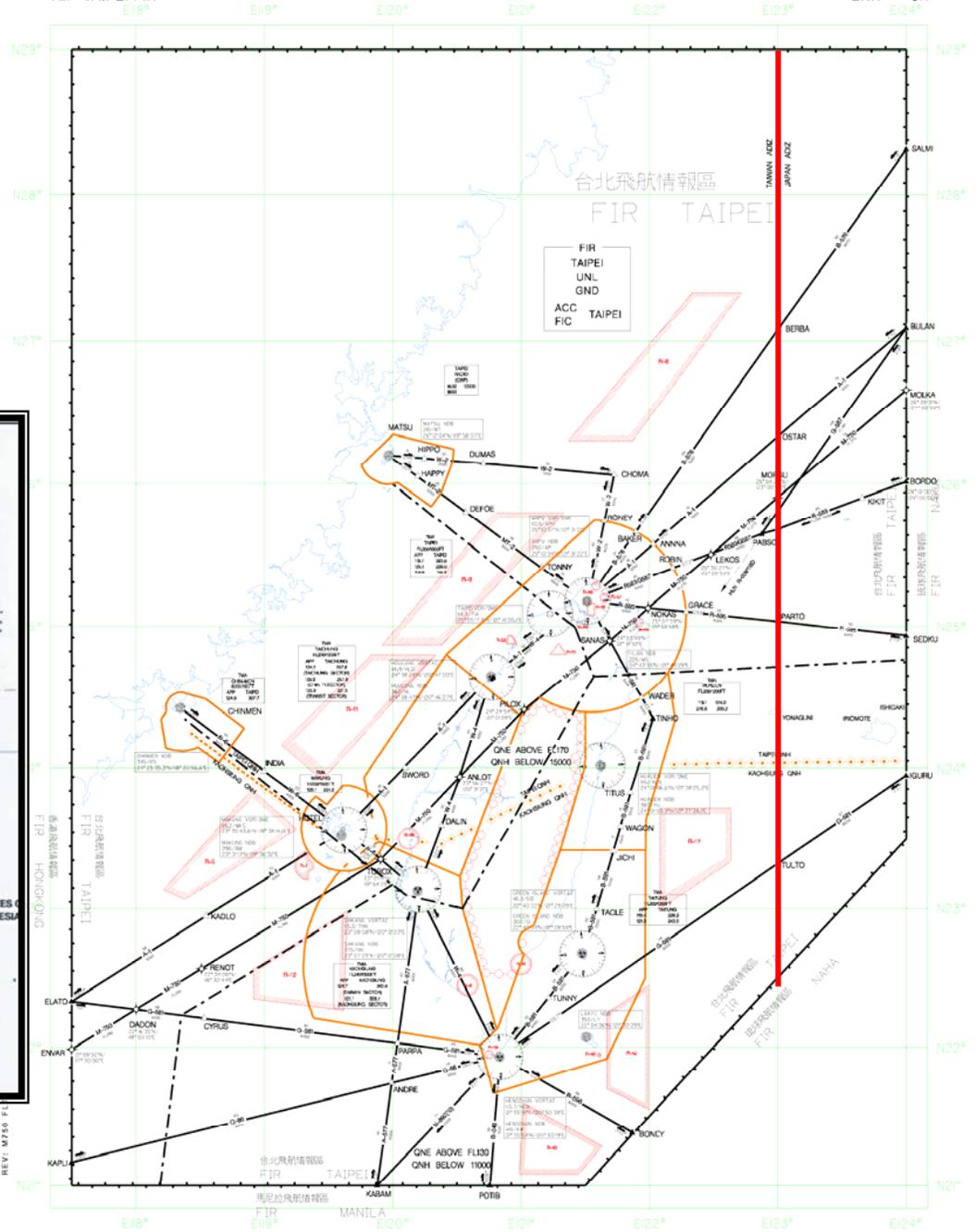
# Taipei FIR



臺北飛航情報區飛航指南  
AIP-TAIPEI FIR

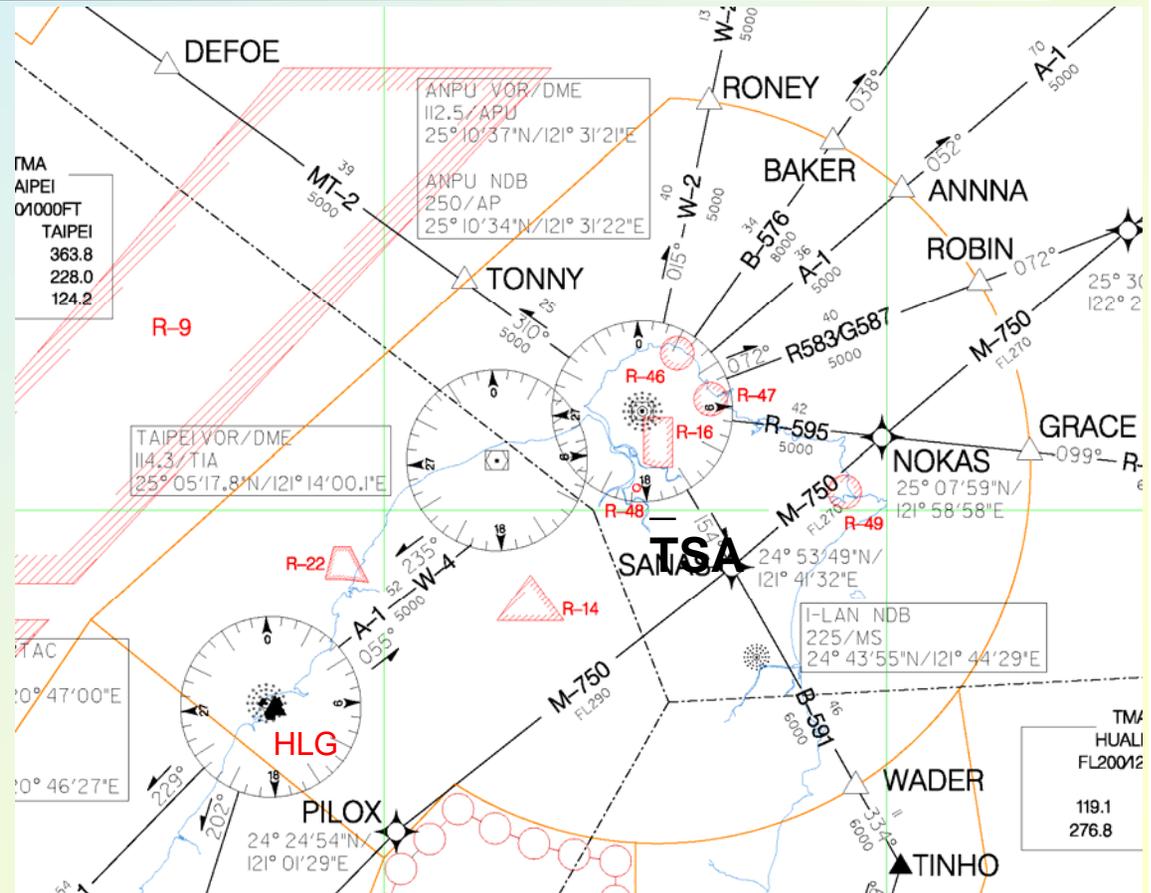
## 台北飛航情報區航路圖 TAIPEI FIR EN ROUTE CHART

航路 6.1  
ENR 6.1



# Taipei TCA

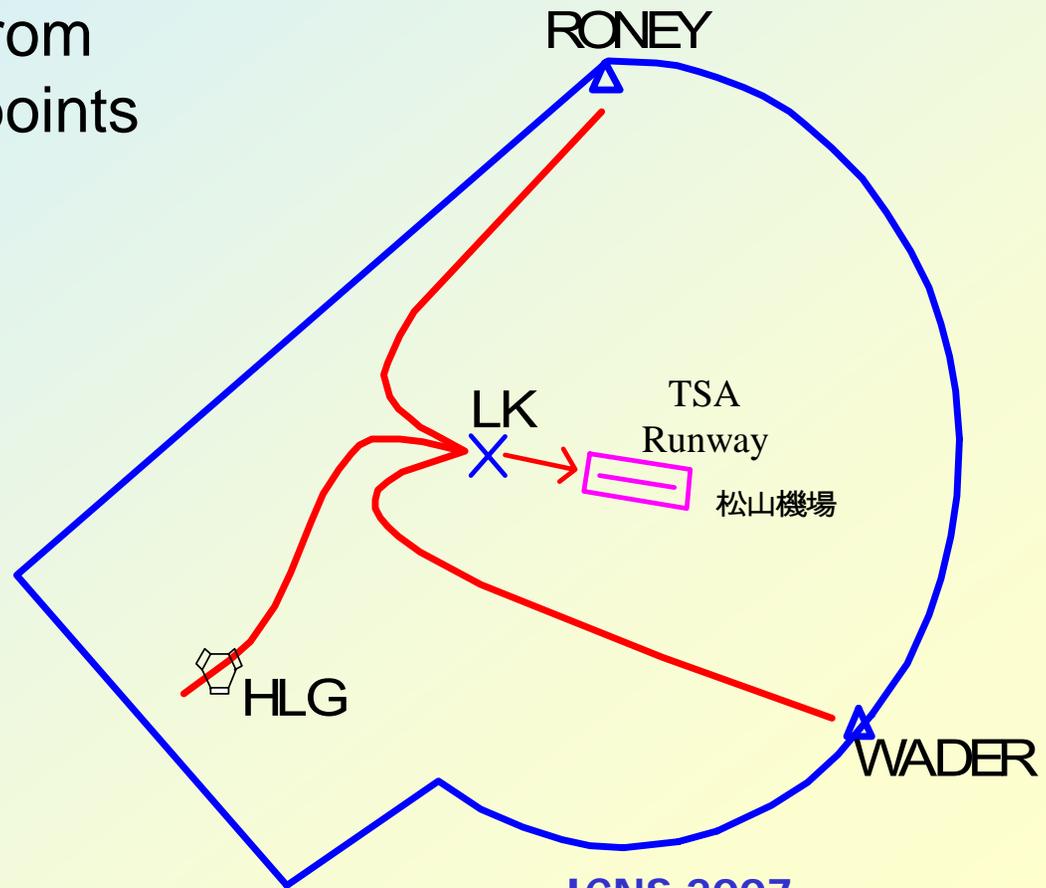
Metering for TSA  
single runway from  
HLG, RONEY,  
WADER to LK FAF,  
proceed to landing  
within 7-12 minutes  
under 9000 feet.





# TSA Approach

TSA approach from  
three metering points  
on easy map



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# Data Supports from SAR

System Analysis Record (SAR) is a statistical data from Air Traffic Control Automation System (ATCAS) to generate quite accurate and reliable flight time data. It is used for flight plans.

737.0 CID 231 AID FEA125 PENDING FLIGHT RECORDED BY DUZ CODE 80												
PPOS	REFX	HFIX	HDEP	PUD	CTYP	ATIP	FAI	ADJ	CHG	LAST	SBI	E
0	0	NULL				0	NO	NONE	NUL	0	NO	F
FIX ID	AKID	TYP	AK ENT	XCOORD	YCOORD	DIR	SPD	DIST	CTA			
RCSS	0	D	APCOND	428.00	417.25	273	400	0.0	0520.0			
RCSS	1	D	CTRFIX	428.00	417.25	273	400	0.0	0520.0			
RCSS	2	D	TOWERD	428.00	417.25	273	400	0.0	0520.0			
RCSS	3	E	APCOND	428.00	417.25	273	400	2.2	0520.0			
RCSS	4	E	CTRFIX	428.00	417.25	273	400	2.2	0520.0			
SL	5	E	APCOND	425.75	417.37	225	400	24.8	0520.3			
MPU218030	6	E	APCOND	408.12	399.87	217	400	10.1	0524.0			
XEROX	7	E	CTRFIX	402.00	391.87	217	400	0.0	0525.5			
TCC10	8	E	CTRFIX	402.00	391.87	217	400	30.0	0525.5			
THP05	9	E	CTRFIX	383.87	368.00	257	400	0.0	0530.0			
TONPU	10	E	CTRFIX	383.87	368.00	257	400	5.8	0530.0			
MQJ4	11	E	CTRFIX	378.12	366.62	199	400	40.5	0530.8			
FLIGHT				SORT=TIME				NAS ID=D7N6040R NAS L				
KHD1	12	E	CTRFIX	364.62	328.50	200	400	0.0	0536.8			
DALIN	13	E	CTRFIX	364.62	328.50	200	400	17.1	0536.8			
DALIN	14	E	APCONO	364.62	328.50	200	400	17.1	0536.8			
KHP04	15	E	CTRFIX	358.87	312.37	199	400	11.8	0539.3			
TNN	16	E	APCONO	355.00	301.12	154	400	37.2	0541.0			
RCKH	17	E	APCONO	371.50	267.75	0	400	0.0	0546.5			
RCKH	18	E	APCONO	371.50	267.75	0	400	0.0	0546.5			
RCKH	19	A	APCONO	371.50	267.75	0	400	0.0	0546.5			

# Basic Assumptions

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- a. Approach routes are fixed, T/O from RCSS, FAF at LK
- b. Only two types A/C of jet or propeller
- c. Apply RNP-1, horizontal separation 40 sec.
- d. Flight time estimation by SAR
- e. OOOI broadcasting available
- f. Adjust flight time by ATC
- g. Ground holdings less than 10 min.
- h. No detour, no holding in air

# Adjusting Flight Time

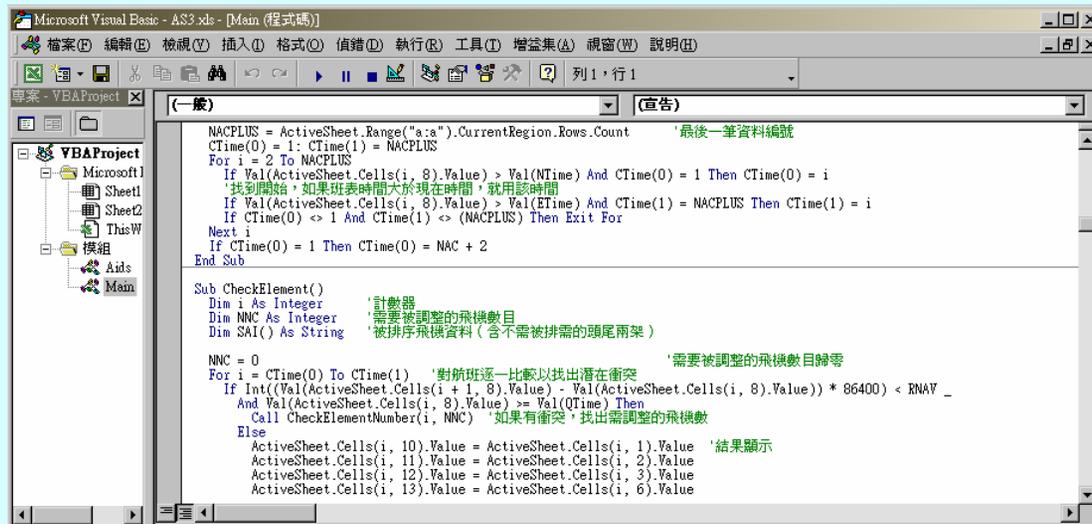
Under ATC operation, jet or propeller aircrafts can adjust flight time by reducing or increasing speed by less than 10 knots.

From Lines to TSA			Jet (400 n-mile speed)		Propeller		
Airport	Route	Distance (N-mile)	Shorter (sec)	Longer (sec)	Shorter (sec)	Longer (sec)	Speed (N-mile)
RCBS	W-4	177.3	39	41	84	91	270
RCYU	B-591	48.5	11	11	25	27	260
RCQC	W-4	53	12	12	27	29	260
RCKH	W-4	95.4	21	22			
RCNN	W-4	95.4	21	22			
RCFN	B-591	152.5	34	35			
RCMT	W-2	149.1			141	157	190
RCLG	W-4	26			20	22	210
RCKU	W-4	66.5			47	52	220
RCDC	W-4	95.4			49	53	220

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# Developing by Excel

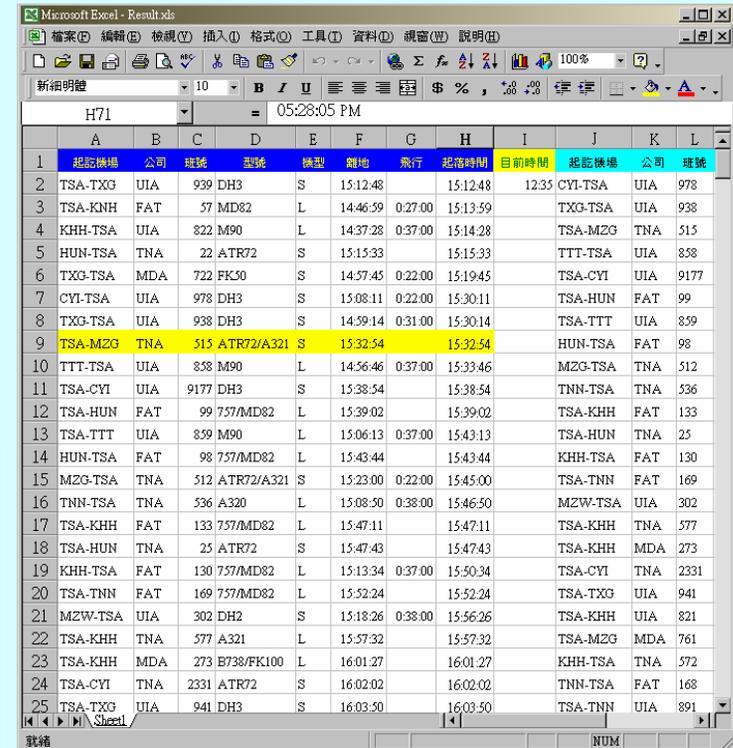
1. EXCEL is a good tool of sequencing data in different types and formats
2. VBA is useful to calculate simple formulations with easy implementation



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Microsoft Visual Basic - AS3.xls - [Main (程式碼)]
檔案(F) 編輯(E) 檢視(V) 插入(I) 格式(O) 值錯(D) 執行(R) 工具(T) 增益集(A) 視窗(W) 說明(H)
專案 - VBAProject
VBAProject
Microsoft1
Sheet1
Sheet2
ThisW
模組
Aids
Main
(一般) (宣告)
NACPLUS = ActiveSheet.Range("a:a").CurrentRegion.Rows.Count '最後一筆資料編號
CTime(0) = 1: CTime(1) = NACPLUS
For i = 2 To NACPLUS
    If Val(ActiveSheet.Cells(i, 8).Value) > Val(NTime) And CTime(0) = 1 Then CTime(0) = i
    '找到開始, 如果班表時間大於現在時間, 就用該時間
    If Val(ActiveSheet.Cells(i, 8).Value) > Val(EndTime) And CTime(1) = NACPLUS Then CTime(1) = i
    If CTime(0) <> 1 And CTime(1) <> (NACPLUS) Then Exit For
Next i
If CTime(0) = 1 Then CTime(0) = NAC + 2
End Sub

Sub CheckElement()
    Dim i As Integer '計數器
    Dim NMC As Integer '需要被調整的飛機數目
    Dim SAI() As String '被排序飛機資料 (含不需被排序的頭尾兩架)

    NMC = 0 '需要被調整的飛機數目歸零
    For i = CTime(0) To CTime(1) '對航班逐一比較以找出潛在衝突
        If Int((Val(ActiveSheet.Cells(i + 1, 8).Value) - Val(ActiveSheet.Cells(i, 8).Value)) * 86400) < RNAV _
            And Val(ActiveSheet.Cells(i, 8).Value) >= Val(EndTime) Then
            Call CheckElementNumber(i, NMC) '如果有衝突, 找出需調整的飛機數
        Else
            ActiveSheet.Cells(i, 10).Value = ActiveSheet.Cells(i, 1).Value '結果顯示
            ActiveSheet.Cells(i, 11).Value = ActiveSheet.Cells(i, 2).Value
            ActiveSheet.Cells(i, 12).Value = ActiveSheet.Cells(i, 3).Value
            ActiveSheet.Cells(i, 13).Value = ActiveSheet.Cells(i, 6).Value
        End If
    Next i
End Sub
```



	A	B	C	D	E	F	G	H	I	J	K	L
1	起點機場	公司	班號	型號	機型	離地	飛行	起降時間	目前時間	起降機場	公司	班號
2	TSA-TXG	UIA	939 DH3	S	15:12:48		15:12:48	12:35	CYI-TSA	UIA	978	
3	TSA-KNH	FAT	57 MD82	L	14:46:59	0:27:00	15:13:59		TXG-TSA	UIA	938	
4	KHH-TSA	UIA	822 M90	L	14:37:28	0:37:00	15:14:28		TSA-MZG	TNA	515	
5	HUN-TSA	TNA	22 ATR72	S	15:15:33		15:15:33		TTT-TSA	UIA	858	
6	TXG-TSA	MDA	722 FK30	S	14:57:45	0:22:00	15:19:45		TSA-CYI	UIA	9177	
7	CYI-TSA	UIA	978 DH3	S	15:08:11	0:22:00	15:30:11		TSA-HUN	FAT	99	
8	TXG-TSA	UIA	938 DH3	S	14:59:14	0:31:00	15:30:14		TSA-TTT	UIA	859	
9	TSA-MZG	TNA	515 ATR72/A321	S	15:32:54		15:32:54		HUN-TSA	FAT	98	
10	TTT-TSA	UIA	858 M90	L	14:56:46	0:37:00	15:33:46		MZG-TSA	TNA	512	
11	TSA-CYI	UIA	9177 DH3	S	15:38:54		15:38:54		TNN-TSA	TNA	536	
12	TSA-HUN	FAT	99 757/MD82	L	15:39:02		15:39:02		TSA-KHH	FAT	133	
13	TSA-TTT	UIA	859 M90	L	15:06:13	0:37:00	15:43:13		TSA-HUN	TNA	25	
14	HUN-TSA	FAT	98 757/MD82	L	15:43:44		15:43:44		KHH-TSA	FAT	130	
15	MZG-TSA	TNA	512 ATR72/A321	S	15:23:00	0:22:00	15:45:00		TSA-TNN	FAT	169	
16	TNN-TSA	TNA	536 A320	L	15:08:50	0:38:00	15:46:50		MZW-TSA	UIA	302	
17	TSA-KHH	FAT	133 757/MD82	L	15:47:11		15:47:11		TSA-KHH	TNA	577	
18	TSA-HUN	TNA	25 ATR72	S	15:47:43		15:47:43		TSA-KHH	MDA	273	
19	KHH-TSA	FAT	130 757/MD82	L	15:13:34	0:37:00	15:50:34		TSA-CYI	TNA	2331	
20	TSA-TNN	FAT	169 757/MD82	L	15:52:24		15:52:24		TSA-TXG	UIA	941	
21	MZW-TSA	UIA	302 DH2	S	15:18:26	0:38:00	15:56:26		TSA-KHH	MDA	821	
22	TSA-KHH	TNA	577 A321	L	15:57:32		15:57:32		TSA-MZG	MDA	761	
23	TSA-KHH	MDA	273 B738/FK100	L	16:01:27		16:01:27		KHH-TSA	TNA	572	
24	TSA-CYI	TNA	2331 ATR72	S	16:02:02		16:02:02		TNN-TSA	FAT	168	
25	TSA-TXG	UIA	941 DH3	S	16:03:50		16:03:50		TSA-TNN	UIA	891	

# Construct the Proposed Method

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- Find from the original daily queue with conflicts
- Check priority during that particular period
- Landing A/C or Small A/C gets higher priority
- First come first serve
- Apply new sequencing methods
- Insert flight
- Increase capacity
- Apply ATC advisory
- Speed adjust
- Ground holding
- Get final queue of the next 50 min.

# Find Conflict

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Variable definition for times

$T_{SS}(N)$ : Nth aircraft to land or T/O from RCSS

$T_{RNP}$ : RNP-X separation time, assume 40 sec  
for RNP-1

$N_c$  : Conflict aircraft number in TCA

# Find Conflict

Two aircraft conflict from Excel:

$$T_{SS}(N) - T_{SS}(N-1) < T_{RNP}$$

Microsoft Excel - Result.xls

檔案(F) 編輯(E) 檢視(V) 插入(I) 格式(O) 工具(T) 資料(D) 視窗(W) 說明(H)

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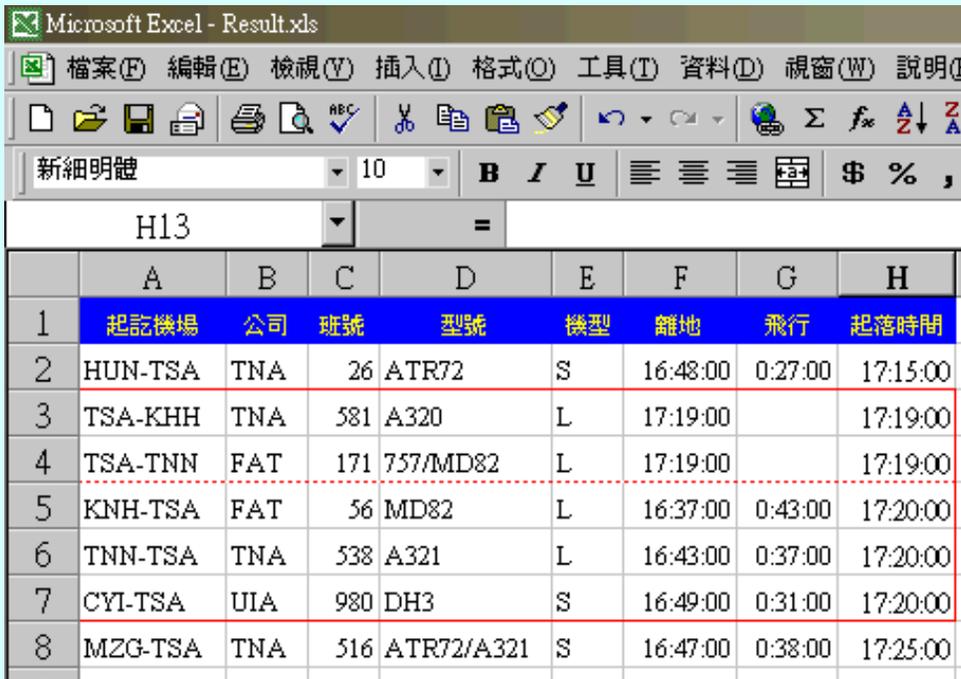
110 =

	A	B	C	D	E	F	G	H
1	起訖機場	公司	班號	型號	機型	離地	飛行	起落時間
2	HUN-TSA	TNA	26	ATR72	S	16:48:00	0:27:00	17:15:00
3	TSA-KHH	TNA	581	A320	L	17:19:00		17:19:00
4	TSA-TNN	FAT	171	757/MD82	L	17:19:00		17:19:00
5	KNH-TSA	FAT	56	MD82	L	16:37:00	0:43:00	17:20:00
6	TNN-TSA	TNA	538	A321	L	16:43:00	0:37:00	17:20:00
7	CYL-TSA	UIA	980	DH3	S	16:49:00	0:31:00	17:20:00
8	MZG-TSA	TNA	516	ATR72/A321	S	16:47:00	0:38:00	17:25:00

# Find Conflict

Regional conflict (several A/C):

$$T_{SS} (N_C + 1) - T_{SS} (1) \geq N_C * T_{RNP}$$



Microsoft Excel - Result.xls

檔案(F) 編輯(E) 檢視(V) 插入(I) 格式(O) 工具(T) 資料(D) 視窗(W) 說明(H)

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H13 =

	A	B	C	D	E	F	G	H
1	起訖機場	公司	班號	型號	機型	離地	飛行	起落時間
2	HUN-TSA	TNA	26	ATR72	S	16:48:00	0:27:00	17:15:00
3	TSA-KHH	TNA	581	A320	L	17:19:00		17:19:00
4	TSA-TNN	FAT	171	757/MD82	L	17:19:00		17:19:00
5	KNH-TSA	FAT	56	MD82	L	16:37:00	0:43:00	17:20:00
6	TNN-TSA	TNA	538	A321	L	16:43:00	0:37:00	17:20:00
7	CYI-TSA	UIA	980	DH3	S	16:49:00	0:31:00	17:20:00
8	MZG-TSA	TNA	516	ATR72/A321	S	16:47:00	0:38:00	17:25:00

# Check Priority

1. Landing A/C gets absolute high priority
2. Earlier "OFF" time with earlier TSS gets higher priority
3. FAT56>TNA538>UIA980>**TNA581>FAT171**

1	起訖機場	公司	班號	型號	機型	離地 OFF	飛行	起落時間 ON
2	HUN-TSA	TNA	26	ATR72	S	16:48:00	0:27:00	17:15:00
3	TSA-KHH	TNA	581	A320	L	17:19:00		17:19:00
4	TSA-TNN	FAT	171	757/MD82	L	17:19:00		17:19:00
5	KNH-TSA	FAT	56	MD82	L	16:37:00	0:43:00	17:20:00
6	TNN-TSA	TNA	538	A321	L	16:43:00	0:37:00	17:20:00
7	CYI-TSA	UIA	980	DH3	S	16:49:00	0:31:00	17:20:00
8	MZG-TSA	TNA	516	ATR72/A321	S	16:47:00	0:38:00	17:25:00

# Check Priority

3. The same  $T_{SS}$ , follows A/C type, propeller gets higher priority than jet

4. Same type of A/C applies FCFS rule

**UIA980** > FAT56 > TNA538 > TNA581 > FAT171

1	起訖機場	公司	班號	型號	機型	離地 <sup>OFF</sup>	飛行	起落時間
2	HUN-TSA	TNA	26	ATR72	S	16:48:00	0:27:00	17:15:00
3	TSA-KHH	TNA	581	A320	L	17:19:00		17:19:00
4	TSA-TNN	FAT	171	757/MD82	L	17:19:00		17:19:00
5	KNH-TSA	FAT	56	MD82	L	16:37:00	0:43:00	17:20:00
6	TNN-TSA	TNA	538	A321	L	16:43:00	0:37:00	17:20:00
7	CYI-TSA	UIA	980	DH3	S	16:49:00	0:31:00	17:20:00
8	MZG-TSA	TNA	516	ATR72/A321	S	16:47:00	0:38:00	17:25:00

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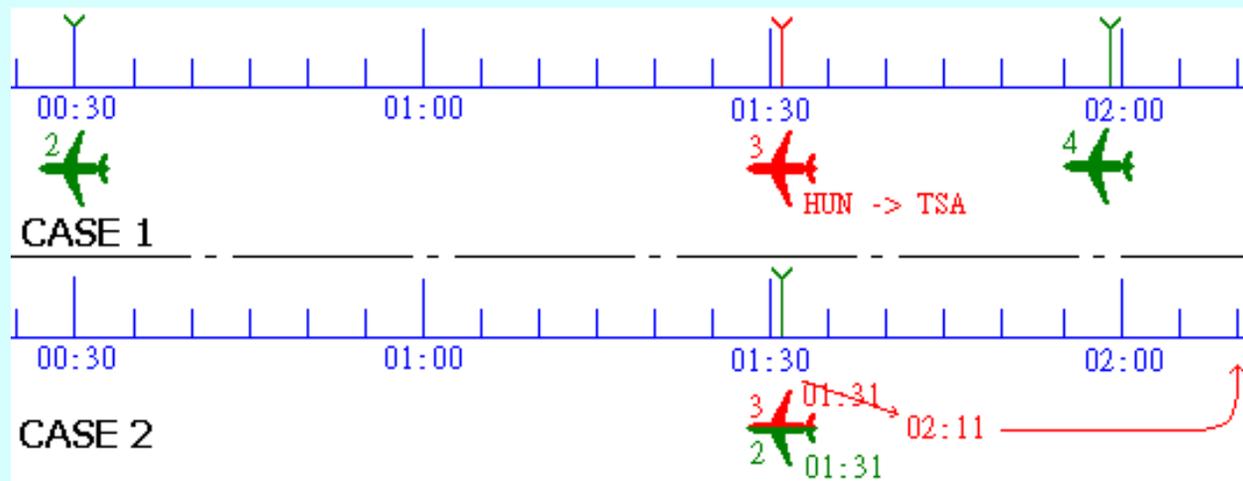
# Apply Sequencing

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1. Insert queuing location
2. Increase capacity: separation limit, adjust limit
3. Final adjustment: single A/C shifts, following A/C delays
4. Repeating process until all  $N_c$  aircraft being checked

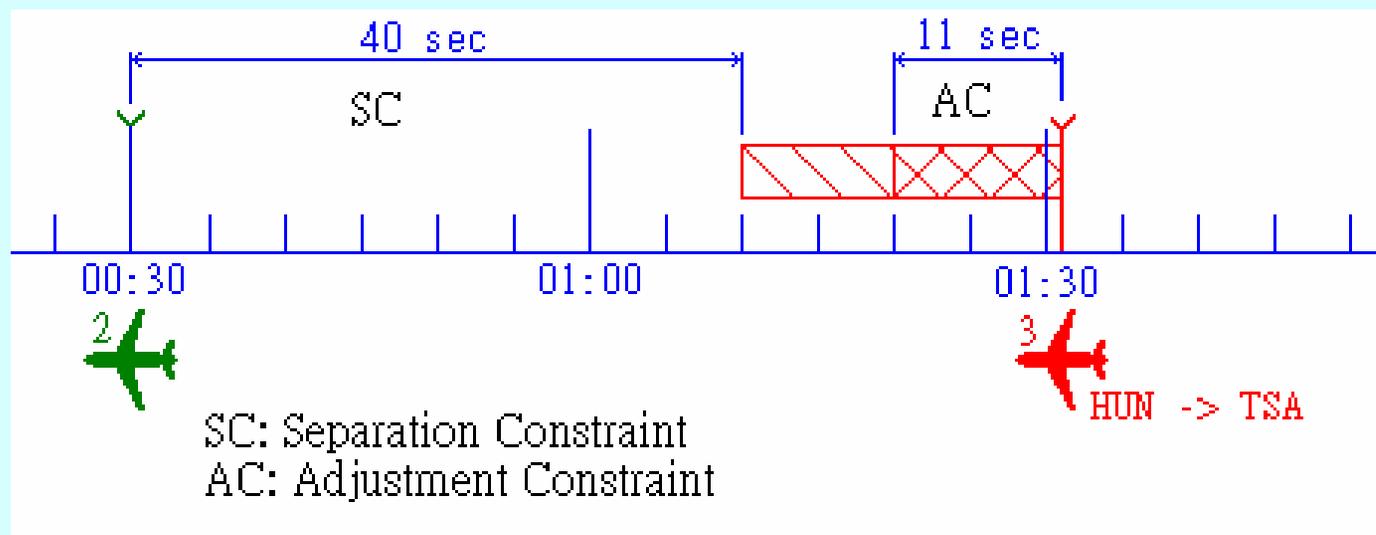
# Sequencing

1. Insert location
2.  $T_{SS}(N-1) \leq T_{SS}(N) < T_{SS}(N+1)$
3. Let  $T_{SS}(N) - T_{SS}(N-1) \geq T_{RNP}$



# Sequencing

## 2. Increase capacity: adjust the limit

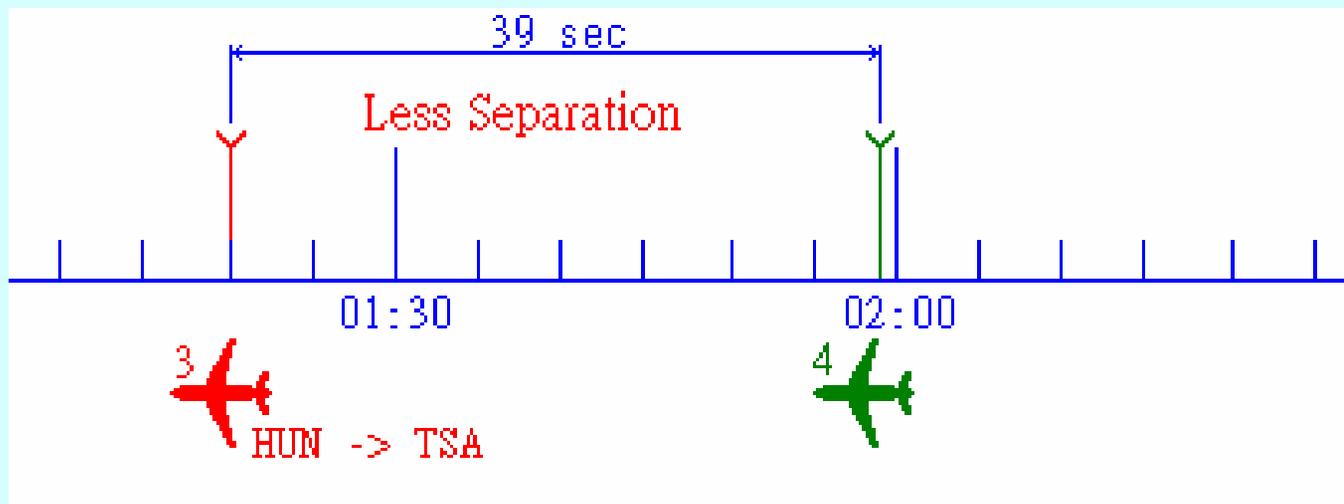


# Sequencing

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3. Final check  $T_{SS}(N+1) - T_{SS}(N) < T_{RNP}$

$$T_{ne} = T_{RNP} - [T_{SS}(N+1) - T_{SS}(N)]$$

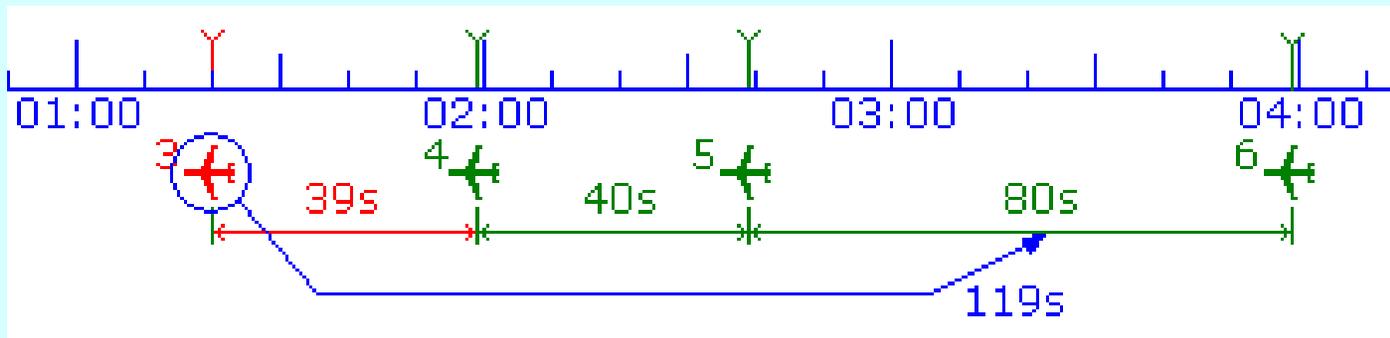


# Sequencing

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3. Final Adjustment - single aircraft

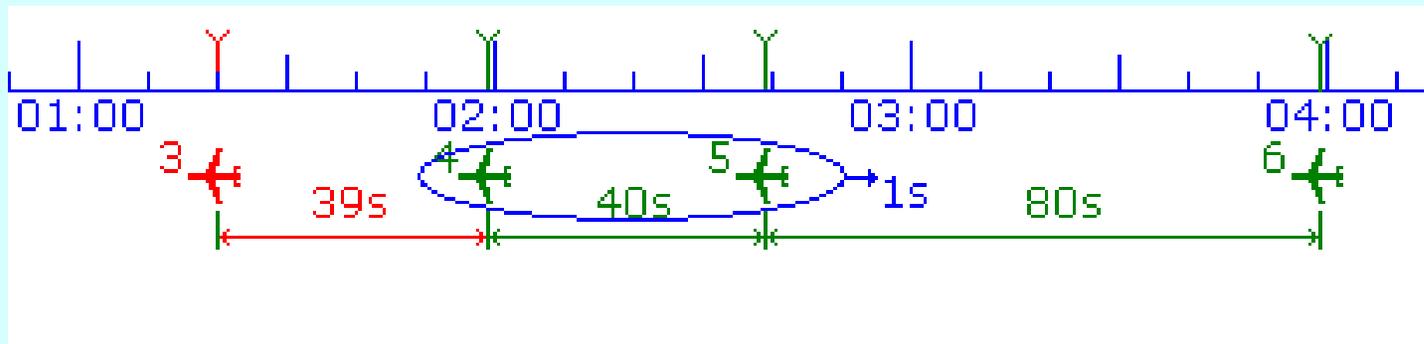
$$4. T_{SS} [(N + 1) + i] - T_{SS} [N + i] \geq 2 T_{RNP}$$



# Sequencing

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3. Final Adjustment - Following aircraft delays
4.  $T_{ss}(N+j+1) - T_{ss}(N+j) > (T_{RNP} + T_{ne})$



# ATC Advisory

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1. Suggest  $dT_{ETA} = T_{ETA} \text{ (before)} - T_{ETA} \text{ (after)}$
2.  $dT_{ETA} < 0$ , arrives earlier
3.  $dT_{ETA} = 0$ , on schedule
4.  $dT_{ETA} > 0$ , delays

# ATC Advisory

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2. Adjustment Suggestion
3. Speed control: aircraft changes speed from + 10 knots to - 10 knots
4. Ground holding: stay on the ground
5. Detour: not apply now
6. Air holding: not apply now

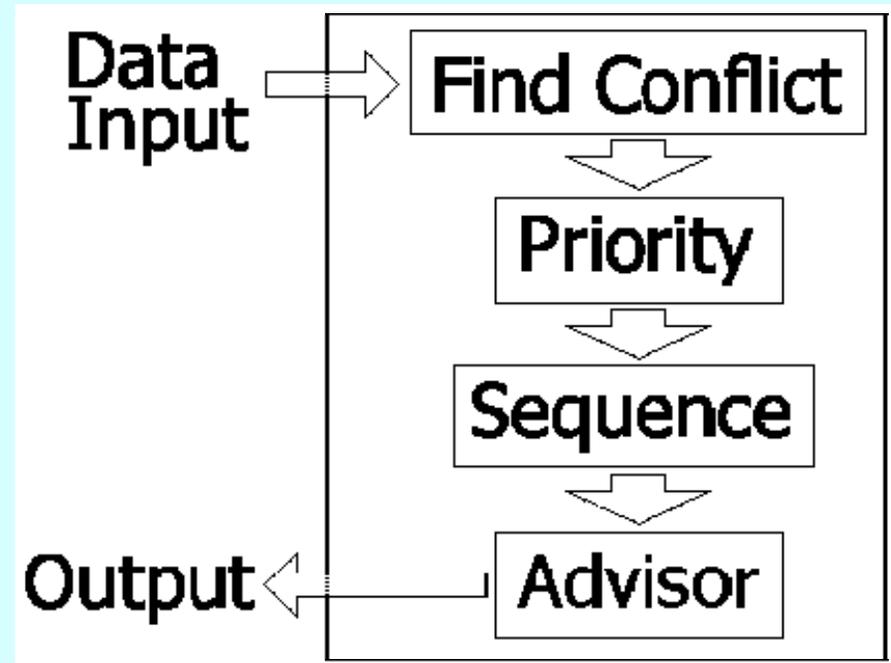
# Queuing Solution

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Adopt daily FDP data  
make the first daily  
queue in Excel

Check every hour and  
change by actual "OFF"  
time, watch for the next  
50 min.

Apply solution methods  
to get new queue for  
ATC within 20 min  
before "ON" time



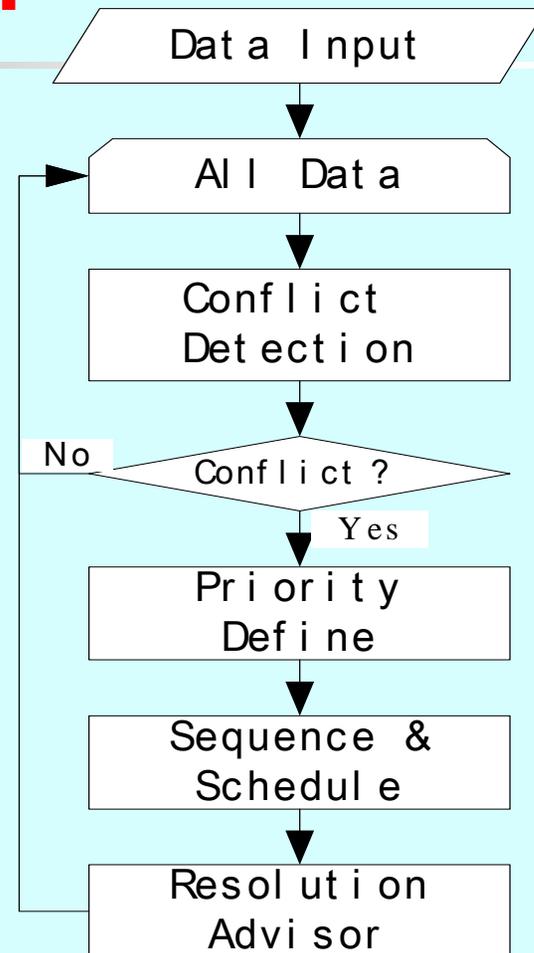
# Solution Algorithm

Use VBA to process calculation and get solution

Compare with other "OFF" time

Solution time takes 0.5~1.5 sec for any changes

Project data onto Excel and refresh new queuing on the ETA column every 2 seconds



# Simulations

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1. Select two part of the daily flow display
2. Check Taipei Sung Shang Airport approach queuing
3. Use VBA software for calculation

# Example 1

3 aircrafts have the same ETA to TSA

Airport	Airline	Flight/AC	ETA/ETD		Airline	Flight	Revised	Suggestion
HUN-TSA	TNA	26/S	17:15:00		TNA	26	17:15:00	
TSA-KHH	TNA	581/L	17:19:00		TNA	581	17:19:00	
TSA-TNN	FAT	171/L	17:19:00		FAT	171	17:19:40	G/H 40 s
KHH-TSA	FAT	56/L	17:20:00		UIA	980	17:20:21	SPD 250 k
TNN-TSA	TNA	538/L	17:20:00		TNA	538	17:21:01	G/H 61 s
CYI-TSA	UIA	980/S	17:20:00		FAT	56	17:21:41	G/H 101 s

# Example 1

3 aircrafts have the same ETA to TSA

起訖機場	公司	班號	機型	起落時間		公司	班號	修正起落	決策建議
HUN-TSA	TNA	26	S	17:15:00		TNA	26		
TSA-KHH	TNA	581	L	17:19:00	→	TNA	581	17:19:00	
TSA-TNN	FAT	171	L	17:19:00	→	FAT	171	17:19:40	地面等候 40秒
KNH-TSA	FAT	56	L	17:20:00	↘	UIA	980	17:20:21	建議平均空速 250節
TNN-TSA	TNA	538	L	17:20:00	→	TNA	538	17:21:01	地面等候 1分 1秒
CYI-TSA	UIA	980	S	17:20:00	↗	FAT	56	17:21:41	地面等候 1分 41秒
MZG-TSA	TNA	516	S	17:25:00		TNA	516		

# Example 2

## Regional conflict solution

Airport	Airline	Flight/AC	ETA/ETD		Airline	Flight	Revised	Suggestion
TSA-CYI	UIA	9177/S	16:38:15		UIA	9177	16:38:15	
TSA-HUN	FAT	99/L	16:40:16		FAT	99	16:40:16	
TSA-TTT	UIA	859/L	16:40:23	→	UIA	859	16:40:56	G/H 33 s
HUN-TSA	FAT	98/L	16:40:39	↗	TNA	512	16:41:36	SPD 250 k
MZG-TSA	TNA	512/L	16:40:52	↘	FAT	133	16:42:15	G/H 27 s
TNN-TSA	TNA	536/L	16:41:03	↘	FAT	98	16:42:56	G/H 137 s
TSA-KHH	FAT	133/L	16:41:48	↘	TNA	536	16:43:36	G/H 153 s
TSA-HUN	TNA	25/S	16:42:14	→	TNA	25	16:44:16	G/H 122 s
KHH-TSA	FAT	130/L	16:50:51		FAT	130	16:50:51	

# Example 2

## Regional conflict solution

起訖機場	公司	班號	機型	起落時間		公司	班號	修正起落	決策建議
TSA-CYI	UIA	9177	S	16:38:15		UIA	9177	16:38:15	
TSA-HUN	FAT	99	L	16:40:16	→	FAT	99	16:40:16	
TSA-TTT	UIA	859	L	16:40:23	→	UIA	859	16:40:56	地面等候 33秒
HUN-TSA	FAT	98	L	16:40:39	↔	TNA	512	16:41:36	建議平均空速 250節
MZG-TSA	TNA	512	S	16:40:52	↔	FAT	133	16:42:15	地面等候 27秒
TNN-TSA	TNA	536	L	16:41:03	↔	FAT	98	16:42:56	地面等候 2分 17秒
TSA-KHH	FAT	133	L	16:41:48	↔	TNA	536	16:43:36	地面等候 2分 33秒
TSA-HUN	TNA	25	S	16:42:14	→	TNA	25	16:44:16	地面等候 2分 2秒
KHH-TSA	FAT	130	L	16:50:51		FAT	130	16:50:51	

# Demonstrations

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1. Receive ACARS "ON" time data in real time
2. Refreshing queuing display on Excel by 2 sec.
3. Simulate ATC advisory
4. Check the feasibility of the proposal method

G1 修正起落														
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
序號	起訖機場	機型	離地	飛行	起落時間	修正起落	序號	建議	隔離	標準	錯誤			
0	TSA-TSA	S	0:00:00		0:00:00	0:00:00	0							
1	TSA-KNH	L	7:02:15		7:02:15	7:02:15	1		7:02:15	0:00:46				
2	TSA-HUN	L	7:03:48		7:03:48	7:03:48	2		0:01:34	0:00:48				
3	TSA-MZG	S	7:10:30		7:10:30	7:10:30	3		0:06:42	0:00:48				
4	KHH-TSA	L	6:36:03	0:37:00	7:13:03	7:12:41	4	建議巡航速度 410 節 <加快>	0:02:11	0:00:46				
5	TSA-KHH	L	7:13:03		7:13:03	7:13:51	5	在地面等候 47 秒	0:01:10	0:01:10	有問題			
6	TSA-CYI	S	7:15:12		7:15:12	7:15:12	6		0:01:21	0:00:48				
7	TSA-TNN	L	7:22:24		7:22:24	7:22:23	7		0:07:11	0:00:46				
8	TSA-KNH	S	7:22:28		7:22:28	7:23:11	8	在地面等候 42 秒	0:00:48	0:00:48	有問題			
9	TSA-HUN	S	7:30:29		7:30:29	7:30:29	9		0:07:19	0:00:46				
10	TSA-TXG	S	7:30:41		7:30:41	7:31:15	10	在地面等候 33 秒	0:00:45	0:00:46	有問題			
11	TSA-KHH	L	7:32:25		7:32:25	7:32:24	11		0:01:10	0:00:46				
12	TSA-CYI	S	7:34:24		7:34:24	7:34:24	12		0:01:59	0:00:48				
13	TSA-PIF	S	7:37:55		7:37:55	7:37:55	13		0:03:31	0:00:46				
14	KHH-TSA	L	7:02:06	0:37:00	7:39:06	7:39:06	14		0:01:11	0:00:46				
15	TSA-KHH	L	7:40:41		7:40:41	7:40:41	15		0:01:35	0:01:10				
16	TNN-TSA	L	7:12:27	0:32:00	7:44:27	7:44:27	16		0:03:46	0:00:48				
17	TXG-TSA	S	7:27:21	0:22:00	7:49:21	7:49:01	17	建議巡航速度 220 節 <加快>	0:04:34	0:01:10				
18	KHH-TSA	L	7:13:01	0:37:00	7:50:01	7:49:50	18	建議巡航速度 405 節 <加快>	0:00:49	0:00:49	有問題			
19	KHH-TSA	L	7:08:33	0:42:00	7:50:33	7:51:00	19	在地面等候 27 秒	0:01:10	0:01:10	有問題			
20	TSA-TXG	S	7:52:29		7:52:29	7:52:29	20		0:01:28	0:01:10				
21	TSA-TNN	L	7:53:13		7:53:13	7:53:14	21		0:00:46	0:00:46	有問題			
22	TSA-KHH	L	7:58:02		7:58:02	7:58:02	22		0:04:48	0:00:48				

執行

G1 修正起落

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
21	TSA-TNN	L	7:53:13		7:53:13	7:53:14	21		0:00:46	0:00:46	有問題			
22	TSA-KHH	L	7:58:02		7:58:02	7:58:02	22		0:04:48	0:00:48				
23	TSA-KHH	L	7:59:52		7:59:52	7:59:52	23		0:01:50	0:00:48				
24	TSA-KHH	L	8:03:21		8:03:21	8:02:51	26	建議巡航速度 230 節 <加快>	0:03:00	0:00:48				
25	TSA-MZG	L	8:03:38		8:03:38	8:03:29	24	在地面等候 8 秒	0:00:38	0:00:38	有問題			
26	CYL-TSA	S	7:22:38	0:41:00	8:03:38	8:04:16	25	在地面等候 38 秒	0:00:48	0:00:48	有問題			
27	KHH-TSA	L	7:27:35	0:37:00	8:04:35	8:05:04	27	在地面等候 29 秒	0:00:48	0:00:48	有問題			
28	HUN-TSA	S	7:39:52	0:27:00	8:06:52	8:06:29	28	建議巡航速度 269 節 <加快>	0:01:25	0:01:10				
29	TSA-CYL	S	8:10:47		8:10:47	8:10:47	29		0:04:18	0:00:38				
30	TSA-TXG	S	8:13:51		8:13:51	8:13:51	30		0:03:04	0:00:46				
31	TSA-HUN	S	8:14:17		8:14:17	8:14:36	31	在地面等候 19 秒	0:00:45	0:00:46	有問題			
32	TNN-TSA	L	7:38:50	0:37:00	8:15:50	8:15:42	32	建議巡航速度 404 節 <加快>	0:01:06	0:00:46				
33	TXG-TSA	S	7:56:40	0:22:00	8:18:40	8:18:40	33		0:02:57	0:01:10				
34	TSA-TTT	L	8:19:26		8:19:26	8:19:26	34		0:00:46	0:00:38				
35	CYL-TSA	S	7:50:40	0:31:00	8:21:40	8:21:40	35		0:02:14	0:00:48				
36	KHH-TSA	L	7:51:01	0:37:00	8:28:01	8:27:40	36	建議巡航速度 410 節 <加快>	0:06:00	0:00:49				
37	TSA-TNN	L	8:28:18		8:28:18	8:28:50	37	在地面等候 32 秒	0:01:10	0:01:10	有問題			
38	HUN-TSA	L	8:07:18	0:22:00	8:29:18	8:29:38	38	在地面等候 19 秒	0:00:48	0:00:48	有問題			
39	TSA-KNH	L	8:30:18		8:30:18	8:30:47	39	在地面等候 28 秒	0:01:10	0:01:10	有問題			
40	TSA-TXG	S	8:33:15		8:33:15	8:33:15	40		0:02:28	0:00:48				
41	TSA-KHH	L	8:35:25		8:35:25	8:35:25	41		0:02:10	0:00:46				
42	TSA-KHH	L	8:41:27		8:41:27	8:41:27	42		0:06:02	0:00:48				
43	MZG-TSA	S	8:05:03	0:38:00	8:43:03	8:42:16	44	建議巡航速度 193 節 <加快>	0:00:48	0:00:48				
44	MZW-TSA	S	8:05:06	0:38:00	8:43:06	8:43:08	43	建議巡航速度 258 節 <減慢>	0:00:53	0:00:53	有問題			

G1		修正起落													資料編輯
A	B	C	D	E	F	G	H	I	J	K	L	M	N		
281	TSA-MZG	L	17:03:48		17:03:48	17:03:48	281		0:00:43	0:00:38					
282	HUN-TSA	L	16:43:38	0:22:00	17:05:38	17:05:27	282	建議巡航速度 410 節 <加快>	0:01:39	0:00:48					
283	KHH-TSA	L	16:29:49	0:37:00	17:06:49	17:06:37	283	建議巡航速度 406 節 <加快>	0:01:10	0:01:10	有問題				
284	TSA-KHH	L	17:09:03		17:09:03	17:09:03	284		0:02:26	0:01:10					
285	TSA-CYI	S	17:09:56		17:09:56	17:09:56	285		0:00:53	0:00:48					
286	TSA-HUN	S	17:12:43		17:12:43	17:12:43	286		0:02:47	0:00:46					
287	HUN-TSA	S	16:46:20	0:27:00	17:13:20	17:13:29	287	建議巡航速度 257 節 <減慢>	0:00:45	0:00:46	有問題				
288	TSA-MZG	L	17:14:44		17:14:44	17:14:44	288		0:01:15	0:00:38					
289	TNN-TSA	L	16:43:05	0:37:00	17:20:05	17:19:33	290	建議巡航速度 230 節 <加快>	0:04:49	0:00:48					
290	CYI-TSA	S	16:49:20	0:31:00	17:20:20	17:20:22	289	建議巡航速度 392 節 <減慢>	0:00:49	0:00:49	有問題				
291	TSA-KHH	L	17:20:29		17:20:29	17:21:32	293	建議巡航速度 399 節 <減慢>	0:01:10	0:01:10	有問題				
292	TSA-TNN	L	17:20:48		17:20:48	17:22:42	291	在地面等候 132 秒	0:01:10	0:01:10					
293	KNH-TSA	L	16:38:29	0:43:00	17:21:29	17:23:29	292	在地面等候 161 秒	0:00:47	0:00:48	有問題				
294	MZG-TSA	S	16:46:04	0:38:00	17:24:04	17:24:17	294	建議巡航速度 256 節 <減慢>	0:00:47	0:00:48	有問題				
295	TSA-TXG	S	17:30:46		17:30:46	17:30:41	296	建議巡航速度 220 節 <加快>	0:06:24	0:00:53					
296	TXG-TSA	S	17:09:02	0:22:00	17:31:02	17:31:19	295	在地面等候 32 秒	0:00:38	0:00:38	有問題				
297	TSA-KHH	L	17:34:00		17:34:00	17:34:00	297		0:02:41	0:00:46					
298	TSA-CYI	S	17:34:31		17:34:31	17:34:47	298	在地面等候 16 秒	0:00:47	0:00:48	有問題				
299	TNN-TSA	L	17:07:13	0:32:00	17:39:13	17:38:52	299	建議巡航速度 410 節 <加快>	0:04:05	0:00:46					
300	TTT-TSA	L	17:02:24	0:37:00	17:39:24	17:40:02	300	在地面等候 37 秒	0:01:10	0:01:10	有問題				
301	KHH-TSA	L	17:09:04	0:37:00	17:46:04	17:46:04	301		0:06:03	0:01:10					
302	TSA-KHH	L	17:48:21		17:48:21	17:48:21	302		0:02:16	0:01:10					
303	TXG-TSA	S	17:29:50	0:22:00	17:51:50	17:51:30	303	建議巡航速度 220 節 <加快>	0:03:09	0:00:48					
304	TSA-TTT	L	17:52:25		17:52:25	17:52:25	304		0:00:55	0:00:38					

# Applications

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1. Application for heavy flow density airports
2. Establish daily FDP as flight data onto Excel display
3. Check metering fixes with update arrival time
4. Queuing all flights in this airport by the proposed method software
5. Approach Center ATC applies advisory control to change queuing data
6. Airport Local Control follows Excel Display for operation
7. Adjust ETA by changing speed +/- 10 knots, short flights may apply ground holding, long flights apply detour or air holding

# Application Example

## Metering fixes for Atlanta Airport

